



NYASALAND PROTECTORATE

Annual Report  
of the  
Department of Agriculture  
1928











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## STAFF LIST

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## Report of the Department of Agriculture for the year 1928.

### EUROPEAN AGRICULTURE.

During the year under review the total area under cultivation by Europeans amounted to 62,230 acres: detailed returns for each district in the Protectorate will be found in Annexure V, and the following summary of crop acreages gives a general survey of the European agriculture of the country in 1928 and 1927 as compared with a decade ago:—

	1918	1927	1928
	acres	acres	acres
Coffee ... ..	1,194	1,239	1,281
Cotton ... ..	18,141	2,545	1,046
Fibres ... ..	1,281	6,282	7,863
Rubber ... ..	4,603	1,320	1,400
Tea ... ..	4,433	7,070	7,596
Tobacco ... ..	6,027	25,002	22,475
Miscellaneous ... ..	17,158	17,465	20,569
Total ... ..	<u>52,837</u>	<u>60,923</u>	<u>62,230</u>

The above figures reveal the fact that in the past ten years cotton has fallen from 18,141 to 1,046 acres, tea has risen from 4,433 to 7,596 acres, and fibres from 1,281 to 7,863 acres. Comparing 1928 and 1927, tobacco and cotton show reductions of 2,527 and 1,499 acres, respectively, while tea and fibres show increases of 526 and 1,581 acres.

Figures indicating the value of European-grown exports, as distinct from native, are not available and the returns given below relate to all agricultural produce exported during the years 1918, 1927, and 1928. Tea, sisal, coffee, and rubber were exclusively European grown; cotton and tobacco must be credited to Europeans and natives in varying proportions for the years to which the returns have reference.

	1918	1927	1928
	£	£	£
Coffee ... ..	4,722	1,203	1,542
Cotton ... ..	156,031	45,834	58,264
Fibres ... ..	8,639	24,428	29,814
Rubber ... ..	2,639	13,049	2,476
Tea ... ..	27,£85	56,640	73,599
Tobacco ... ..	279,511	780,964	496,561
Miscellaneous ... ..	10,153	3,223	6,567
Total ... ..	<u>489,680</u>	<u>925,341</u>	<u>668,823</u>

*Tobacco.*—In 1927 the European tobacco crop was the largest on record for Nyasaland as regards acreage, production, and estimated value; in 1928 the area under cultivation fell to 22,475 acres from 25,002 acres and the production from 93,647 cwts. to 81,355 cwts. The exports (European and native) fell from 15,466,032 lbs. in 1927 valued at £780,964 to 11,632,497 lbs. in 1928 valued at £496,561.

The acreage, production, and yield per acre on European estates in 1928 were as follows:—

District	Acreage	Production cwts.	Yield per acre lbs.
Cholo ... ..	6,033	23,499	436
Zomba ... ..	3,925	12,599	360
Blantyre ... ..	2,906	11,490	443
Mlanje ... ..	1,834	5,234	320
Ncheu ... ..	1,728	5,355	347
Chiradzulu ... ..	1,687	7,099	477
South Nyasa ... ..	1,480	5,008	379
Lilongwe ... ..	866	3,649	472
Central Shire ... ..	701	2,741	438
Dedza ... ..	572	1,710	335
North Nyasa ... ..	194	844	487
Upper Shire ... ..	188	984	586
Chikwawa ... ..	150	354	264
Dowa ... ..	109	427	475
Lower Shire ... ..	52	138	297
Fort Manning ... ..	50	184	439
Kasungu ... ..	20	40	224
Total ... ..	<u>22,475</u>	<u>81,355</u>	<u>405</u>



A shortage of rain in February threatened to curtail greatly the tobacco crop but the drought proved less severe, except in restricted areas, than it was feared that it would be, and the average yield per acre was 405 lbs.

Planters, in recognition of the stagnation of the home market for Empire-grown brights, turned their attention mainly to the production of semi-brights and darks and the quantity of brights exported was negligible as compared with the shipment of this class of tobacco during the previous year. The restricted planting of brights in Nyasaland, coupled with the reduction of the acreage in Southern Rhodesia, has not yet had any noticeable effect on the home market, and it is keenly disappointing that much of the brights exported in 1927 still remain unsold. Market reports also show that darks, with the exception of wrappery tobacco of good quality, can only be sold with difficulty, unless the tobacco is sacrificed at prices that leave no profit, or that entail a loss to the owner.

Market depressions occur from time to time in the history of any industry but writing with knowledge of the unfavourable weather conditions for tobacco in many parts of the Southern Province in the 1929 season, it is difficult not to share the pessimism of those planters who have had so little return in recent seasons from their tobacco estates owing to conditions beyond their control. The problem of alternative crops to tobacco is extremely difficult of solution owing to climatic and transport limitations, and there is little that can be added to the observations that I made on this subject in my annual report for 1927.

In Annexure II will be found the report of the Agricultural Chemist which deals largely with matters relating to tobacco growing and which should be studied by all tobacco growers in conjunction with the various publications on tobacco culture issued by this officer.

*Cotton.*—Cultivation of cotton by Europeans has rapidly declined in recent years and in 1928 the area planted to this crop was no more than 1,046 acres; in the past one estate alone had under cultivation over 5,000 acres of cotton. In view of the pressing need for alternative crops to tobacco, the virtual abandonment of cotton by European planters is a matter for regret.

Encouraging results were obtained with the variety Over-the-Top on co-operative trial plots of five acres each organized by the Empire Cotton Growing Corporation on estates in various centres; the yield averaged 400 lbs. of seed cotton to the acre and in one case a yield of over 800 lbs. was reported. Foster Whitehall, another introduction by the Corporation, gave good returns on the Lower River.

It is satisfactory to observe that a number of estate owners are anxious to plant cotton in rotation with tobacco, and there was a keen demand for Over-the-Top seed for this purpose.

*Tea.*—Each year since 1923 it has been possible to report a steady increase in the tea acreage and in 1928 there was a total of 7,596 acres under cultivation with this crop, the production for the year amounting to 1,407,728 lbs. Both figures are the highest recorded for Nyasaland.

Establishing new tea gardens is of necessity a comparatively slow task, and much credit is due to those responsible for the progress that has been made in recent years. Apart from the actual increase in acreage, there has been a determined effort on a number of estates to raise the crop harvested to a figure more in line with the acre yields reported from tea districts in other parts of the world. New jats have been introduced; measures for checking soil erosion are being adopted; and a start has been made in the use of fertilisers.

Our tea industry owes a debt of gratitude to Dr. E. J. Butler, F.R.S., Director of the Imperial Bureau of Mycology, for his investigations in the previous year and for his comprehensive report, which was published by the department in 1928. Two ideas stand out conspicuously in Dr. Butler's report: the first is the warning that apparently healthy tea-gardens will deteriorate if plant sanitation measures are not energetically carried out; the second is the encouraging view that the poorer fields can by proper attention be brought to a satisfactory standard of productivity.

In addition to Dr. Butler's report, two publications of interest to tea growers were issued by the department: "The Mosquito Bug in Nyasaland and Notes on two potential Pests of Tea" by the Government Entomologist, and "Scheme of Manuring for Tea Land" by the Agricultural Chemist.

*Coffee.*—The area under coffee in 1928 was 1,281 acres as compared with 1,194 acres in 1918. There is little that can be added to the observations that have been made regarding coffee culture in annual reports of the department for recent years. Climatic conditions in Nyasaland are far from ideal for this crop, but there is sufficient evidence to indicate that those who give close personal attention to the combating of pests and diseases and to the building up of the humus content of their soils may expect reasonably profitable returns. The slightest slackening off in the carrying out of the measures recommended by the Government Entomologist in publications previously issued will inevitably result in failure and loss.

*Rubber.*—There was a decrease of 211 cwts. in the production of rubber due to the low prices prevailing. This crop is confined to the Vizara Estate and there are no prospects of new estates being opened up.

*Sisal.*—The area planted to sisal has steadily increased in recent years. In 1928 the new plantings amounted to 1,581 acres, bringing the total up to 7,863 acres. The production reached 23,580 cwts. and the value of the exports was approximately half that of the cotton produced by Europeans and natives and was more than a third of the value of the tea exported.



## NATIVE AGRICULTURE.

As in previous years, the only crops grown for export by natives were tobacco and cotton, with the exception of a small quantity of groundnuts. In 1928 natives produced 37 per cent. of the tobacco crop of the country and 93 per cent. of the cotton as compared with 12 per cent. and 24 per cent. respectively, in 1918.

*Tobacco.*—In 1927 the record native production of 3,484 tons of tobacco proved to be rather more than the local buyers could absorb, and many natives found it extremely difficult to dispose of filler grades while prices generally were lower than in the previous year. The result was a large reduction in the number of growers, the registered number falling from 63,321 to 34,761. The production fell to 2,414 tons. With market conditions as uncertain as they were for Empire-grown tobacco, the reduction in the number of growers could not be regarded as a matter for regret, especially as many of the natives who abandoned this crop had been tempted to rush into tobacco growing by the phenomenal prices of the previous year, and were not the type likely to produce tobacco of good quality.

Statistics relating to the native tobacco industry in 1928, as compared with previous years, are given below :—

### PRODUCTION 1924-1928.

				Tons
1924	...	...	...	525
1925	...	...	...	1,177
1926	...	...	...	2,023
1927	...	...	...	3,484
1928	...	...	...	2,414

### PURCHASES IN DISTRICTS.

				1927	1928
				Tons	Tons
Mlanje	...	...	...	364	143
Cholo	...	...	...	353	81
Blantyre	...	...	...	345	150
Chiradzulu	...	...	...	562	474
Zomba	...	...	...	193	204
Upper Shire	...	...	...	14	13
South Nyasa	...	...	...	22	5
Ncheu	...	...	...	187	50
Dedza	...	...	...	86	22
Lilongwe	...	...	...	860	820
Dowa	...	...	...	384	445
Kota Kota	...	...	...	66	1
Kasungu	...	...	...	—	1
Fort Manning	...	...	...	48	5
Total				<u>3,484</u>	<u>2,414</u>

### NUMBERS OF NATIVES REGISTERED AS TOBACCO GROWERS 1927 AND 1928.

				1927	1928
Mlanje	...	...	...	7,071	1,861
Cholo	...	...	...	1,716	242
Blantyre	...	...	...	2,048	1,000
Chiradzulu	...	...	...	9,470	8,085
Zomba	...	...	...	8,333	2,044
Upper Shire	...	...	...	1,067	215
South Nyasa	...	...	...	478	51
Ncheu	...	...	...	2,864	938
Dedza	...	...	...	3,287	920
Lilongwe	...	...	...	13,291	10,720
Fort Manning	...	...	...	2,850	479
Dowa	...	...	...	10,303	6,110
Kasungu	...	...	...	1,119	672
Kota Kota	...	...	...	2,424	1,424
				<u>66,321</u>	<u>34,761</u>

The policy adopted by the Native Tobacco Board of concentrating their work of supervision in the Lilongwe and Dowa districts was continued, and four of their five European supervisors were stationed in this area. The task of instructing and influencing the large number of native growers widely scattered in this area is not a light one, and it is gratifying to be able to report that the work of the Board met with a large measure of success.

Too much stress cannot be laid on the importance of quality as the aim of native tobacco growers, and it was to this end that the work of the supervisors was directed. General instruction was given in the best methods of culture and curing. Three projects in particular were decided upon as important features of the year's work. Firstly, improvement in the seed supply; this was accomplished by legislation dating from 1927 that prohibited the planting of seed not issued or approved by the Board. Secondly, correct topping and priming; a marked improvement was noticeable in this respect and a practice that was at first abhorrent to the native mind, as being wasteful of potential tobacco, is now becoming routine in these districts. Thirdly, checking the habit of curing on the roofs of huts; in 1927 this practice, which was responsible for much tobacco of poor quality, was prevalent in certain areas, but in 1928 it was difficult to find any instances of its survival.

The tobacco industry of the Lilongwe and Dowa districts is a striking instance of the development of a native industry. In 1925 the production of tobacco in these two districts was 192 tons; in 1928 it had risen to 1,265 tons. Only a few years ago the natives possessed practically no knowledge of tobacco growing; to-day, their tobacco attracts a large number of buyers from the Southern Province.



*Cotton.*—With the decline of European cotton growing it is very satisfactory that there was a substantial increase in the production of this crop by natives who in 1928 grew 2,486 tons of seed cotton as compared with 1,387 tons in 1927. Production figures for the whole country for 1920-1928 and district returns for 1927 and 1928 are given below :—

SEED COTTON				(TONS)
1920	...	...	...	315
1921	...	...	...	375
1922	...	...	...	392
1923	...	...	...	747
1924	...	...	...	1,369
1925	...	...	...	2,909
1926	...	...	...	2,197
1927	...	...	...	1,387
1928	...	...	...	2,486

#### DISTRICT PRODUCTION.

		1927	1928
Lower Shire	...	779	1,377
Chikwawa	...	352	889
Central Shire	...	147	129
Mlanje	...	25	10
Blantyre	...	24	4½
Ncheu	...	16	19
Upper Shire	...	11	8
South Nyasa	...	4	1½
Dedza	...	21	11
Dowa	...	8	37
		<u>1,387</u>	<u>2,486</u>

Prices paid during the season were 1½d.-2d. for No. 1, 1d.-1½d. for No. 2, and ¾d. for No. 3; a total sum of £48,603 was distributed to native growers in 1928 as against £19,748 in 1927.

In 1927 the agreement with the British Cotton Growing Association was renewed for a further period of three years. Completed returns for the five years during which the first agreement was in operation are now available and are of considerable interest; a total of 8,292 tons of seed cotton was purchased from natives for which they received £147,575; charges for handling, ginning, shipping, and selling amounted to £100,228 of which transport to ginnery absorbed £11,251, railway charges to port £17,803, and ocean freight £10,581. There was a profit to Government and a loss to the Association, while natives sold their cotton, on the average, at prices somewhat in excess of what market conditions warranted. In the five years period prior to the agreement the average production per annum was 349 tons; for the five years of the agreement it rose to 1,658 tons.

The agreement, which met with a considerable amount of opposition at its inception, has proved to be highly beneficial to the country, and I desire to acknowledge the generous manner in which Mr. J. A. Lee, Manager of the Association, has always interpreted its terms and the keen interest that he has taken in ensuring its successful working.

A disappointing feature of native cotton growing has been the decline in recent years of this industry in all areas other than the Port Herald, Chikwawa, and Central Shire districts, but there is evidence that in the Bwanje Valley and the Lake Shore belt of the Dowa and Dedza districts there will be an appreciable increase in 1929.

*Food Crops.*—Failure of the February rains in certain parts of the country led at the time to the general belief that serious famine conditions would have to be faced later in the year. The areas where the outlook was most alarming were the Chikwawa district, where the early maize crop was almost a complete failure, the southern shore of Lake Shirwa, the Tuchila plain, and the lower levels of the Ncheu and Dedza districts. Fortunately, a vast improvement in crop prospects followed on the rains that fell in March and April; not only did the crops in the ground recover, but the carry over of moisture in the soil proved most beneficial to the catch crops planted later in the year. At the end of the year a shortage of food was experienced in restricted areas, but the natives were as a rule able to obtain food from neighbouring districts.

The District Agricultural Officer stationed at Fort Johnston and the supervisors attached to the Native Tobacco Board have made it an important part of their district work to impress on natives the urgency of paying proper attention to their food crops. Over eight tons of high-yielding strains of Potchefstroom Pearl maize, as well as seed of other food crops, were distributed to natives in selected centres in various parts of the country. Much, however, remains to be done to improve the methods adopted by natives in the cultivation of their food crops and to overcome the prejudice that many have to the use of drought-resisting crops such as cassava and mapira. Only slow progress can be reported as a result of the persistent efforts made to encourage the more widespread growth of such useful fruits as bananas, papaws, and mangoes, all of which are in bearing at the time of the year that any food shortages is most acutely felt.

#### PRODUCTION FOR EXPORT IN PROVINCES.

The total of agricultural products grown for export in each of the four provinces of the Protectorate varies between wide extremes. Figures showing the production in 1928 in relation to the land area and the native population are given below :—

PRODUCTION FOR EXPORT.									
		Area		Native Population		Tons		Lbs per Square Mile	
Province		Square Miles							Lbs per capita
Southern	...	6,880	...	373,113	...	5,977	...	1,946	35.9
Zomba	...	5,416	...	243,906	...	1,158	...	478.9	10.6
Central	...	8,882	...	400,221	...	1,939	...	488.8	10.8
Northern	...	16,418	...	286,886	...	115	...	15.7	.9



The tonnage shown above was made up as follows:—

Province	Cotton	Coffee	Fibres	Rubber	Tea	Tobacco	Total
Southern—							
European	... 50	... 21	... 1,179	... —	... 628	... 2,528	... 4,406
Native	... 723	... —	... —	... —	... —	... 848	... 1,571
Zomba—							
European	... 1	... 2	... —	... —	... —	... 930	... 933
Native	... 3	... —	... —	... —	... —	... 222	... 225
Central—							
European	... 1	... 10	... —	... —	... —	... 566	... 577
Native	... 20	... —	... —	... —	... —	... 1,342	... 1,362
Northern—							
European	... —	... —	... —	... 69	... —	... 44	... 113
Native	... —	... —	... —	... —	... —	... 2	... 2
Total	798	33	1,179	69	628	6,482	9,189

Taking the native as the labour unit, irrespective of whether he works for a European or for himself, the per capita production for export varied from 35.9 lbs in the Southern Province to 0.9 lbs in the Northern. Within the provinces, also, are striking differences per capita, or per square mile, if administrative district or arbitrary areas are considered. Different degrees of development may be traced to a variety of causes; to elevation, rainfall, and soil; to transport facilities; to the enterprise of European companies and individual planters; to the industry of natives; and, at times, to the influence of chiefs.

Freehold land has been particularly well developed in the tea belt of Mlanje, in the tobacco areas of Cholo, and on the sisal plantations in the Cholo and Port Herald districts. With regard to Crown Land: the production of tobacco and maize in the Chiradzulu district is creditable; rapid strides have been made in the Lilongwe district in the past five years; and the cotton grown by natives in the Chikwawa and Port Herald districts in 1928 represented 85 per cent. of the total for the whole country. As illustrating the influence of a chief, the per capita production of cotton in the Lisungwe area is noteworthy.

#### AGRICULTURAL SURVEYS.

A considerable proportion of the time of the Assistant Director, Mr. E. W. Davy, was taken up with examination of the agricultural possibilities of the Bwanje Valley and the West Nyasa district. Mr. Davy's recommendations for the best utilization of these little-known areas were submitted to Government, and a report prepared by him that will prove of general interest is attached (Annexure I).

#### REPORT OF THE AGRICULTURAL CHEMIST.

The Agricultural Chemist, Capt. A. J. W. Hornby, has been engaged during the year under review almost exclusively on duties connected with the tobacco industry and has combined advisory work on fertilisers, soils, and general tobacco culture with supervision of the experimental stations at Zomba and Matiti. In addition, he has undertaken such laboratory investigations as the time at his disposal permitted. Capt. Hornby's report outlining the result of his work for the year is attached (Annexure II).

#### DISTRICT AGRICULTURAL WORK.

Mr. F. Barker, District Agricultural Officer, had his headquarters at Fort Johnston and his report on the experimental and district work accomplished by him during the year is attached (Annexure III).

The vacancy created by Mr. Clegg's transfer to the Education Department in May was not filled by the end of the year, owing to unavoidable circumstances, and Mr. G. M. Boby and Mr. J. F. Logie were employed as temporary district agricultural officers on the Lower River and in the Ncheu district, respectively.

Reference has been made under the heading Native Agriculture to the district work of the supervisors of the Native Tobacco Board whose duties include attention to food crops in addition to their tobacco work.

#### EMPIRE COTTON GROWING CORPORATION.

During the year the Corporation have maintained their experimental stations at Makwapala and Port Herald where a number of varieties and strains of cotton are being tested, as well as various rotation crops. Seed of Over-the-Top has been bulked and distributed to both Europeans and natives in fair quantity, and smaller lots of other strains have been issued for experimental trial.

Proposals were set on foot during the year by Mr. H. C. Ducker for the opening of a cotton station in the Dowa district with a view to studying the special cotton problems of the Lake Shore; a suitable plot of land has been selected and it is expected that the initial operations will commence early. To the north and south of the proposed station are comparatively large tracts of potential cotton land and, looking to the possibility of railway development, investigational work in this area assumes special importance.

I must again express my gratitude to Mr. Ducker and other members of the Corporation staff for their ready co-operation with the Department of Agriculture.

A summary of the Corporation's work in this country during the year under review is attached (Annexure IV).

#### PUBLICATIONS ISSUED IN 1928.

##### *Agronomic Series.*

Circular No 3.—“Scheme of Manuring for Tea Land,” A. J. W. Hornby, B.Sc., A.I.C., Agricultural Chemist.

Leaflet No. 5.—“Recommendations with Reference to the Fertilization of Tobacco Grown on Average Soils for 1928,” A. J. W. Hornby, B.Sc., A.I.C., Agricultural Chemist.



*Entomological Series.*

Bulletin No. 3. — "Root Gallworm in Tobacco Seed-beds in Nyasaland," Colin Smee, D.I.C., F.E.S., Entomologist.

Bulletin No. 4.— "The Mosquito Bug in Nyasaland and Notes on two potential Pests of Tea," Colin Smee, D.I.C., F.E.S., Entomologist.

"Report on Some Diseases of Tea and Tobacco in Nyasaland," Dr. E. J. Butler, C.I.E., D.Sc., F.R.S., Director, Imperial Bureau of Mycology.

STAFF.

In 1928 the Government Entomologist, Capt. Colin Smee, was on leave from the 4th April to 6th December. Mr. N. D. Clegg was transferred in June to the Department of Education. During the period of his service with the Department of Agriculture Mr. Clegg did much to develop the native cotton industry of the Lower River.

It gives me much pleasure to acknowledge my indebtedness to the officers of the department for the good work accomplished by them during the year under review.

E. J. WORTLEY,  
Director of Agriculture.

ZOMBA, 7th May, 1929.



## Agricultural Surveys.

Apart from my normal duties, which do not provide matter of interest for an Annual Report, approximately one-third of the year was devoted to agricultural survey work in connection with three distinct areas. These were the Bwanje Valley in the Ncheu district, the Vipya which is common to Momberas and West Nyasa, and the more tropical areas of the West Nyasa district.

*Bwanje Valley.*—This valley which commences a few miles north of Balakas, on the Liwonde-Ncheu road, runs in a direction which is almost north, to the south-west arm of Lake Nyasa, the portion falling within the Ncheu district being about sixteen miles in length, with an average width of six to seven miles. On the western side it is bordered by a steep rocky scarp, whereas on the east there is a very gradual transition from the Bwanje River to the dividing line between this river's drainage area and those of more easterly areas. The area of the valley on the left bank is roughly three times the size of that on the right bank, and the soils on the left bank are also vastly superior in depth, uniformity and agricultural potentialities. The deep alluvium characteristic of the land between the left bank and the scarp extends a very short distance from the right bank, and gradually merges into very thin stony or gritty soils with numerous outcrops of rock. It is along these thin stony soils that the Blantyre-Kasanga railway extension has been surveyed.

The economic development of this area has been limited by the scarcity of water during the greater portion of the year, and its future development is dependent on the quantity and quality of water that can be obtained from wells throughout the valley. Except for a few small streams or springs on the western scarp, and one spring on the eastern side of the valley there appears to be no surface water anywhere for some eight months of the year. The natives in the few existing villages obtain supplies of drinking water by sinking wells in or near the bed of various streams, principally the Bwanje, but even then the supply is precarious toward the months of September and October, owing to these primitive wells not being carried to sufficient depth. Only experiment can determine what quantities of water can be supplied throughout the valley by means of proper wells, but it is difficult to visualise the provision of enough to ensure irrigation for any crops at the critical period of the year. The natural vegetation is decidedly xerophytic in character, indicating an arid climate during a considerable portion of the year. Atmospheric humidity is probably satisfactory from January to March, but according to native evidence the rains are very erratic, and the wet seasons are generally characterised by very heavy storms at long intervals, followed by long hot sunny periods. These conditions would cause much difficulty in getting a good stand of tobacco, apart from the earlier difficulty of establishing good and extensive nurseries, owing to water shortage. If a good stand could be secured, growth should be exceptionally good, but early cessation of rains, coupled with a return of strong drying winds, with low atmospheric humidity, would result in great difficulty being experienced in final curings, and in the handling of a probably well-grown crop. The area would appear to be well suited for the cultivation of sorghums, groundnuts and cotton on a large scale, and sisal should be a great success if sufficient water could be assured for running an up-to-date factory during the whole of the cropping season.

At the time of the survey (mid-July) the vegetation was already practically leafless, and bush fires had gone through most of the valley, and this prevented any serious investigations into the flora of the area. The general type is very similar to that encountered along the drier portions of the Shire valley at a distance of some miles from the river. Euphorbias of the candelabra type, and the "Ngachi"—*Euphorbia media*—occur frequently on the thinner soils. On the deeper alluvium, species of *Acacia* and other Leguminosae grow to a fine size, and are very plentiful, as are various Combretaceæ. Baobabs and palm trees are not very plentiful. "Sanya" occurs in isolated patches. Creeping and climbing plants are not abundant, except along watercourses, and grasses had already been burnt out everywhere.

*The Vipya.*—This term is applied indiscriminately to the elevated lands that lie on the eastern side of Momberas district and the western side of the West Nyasa district—a large area roughly lying from 4,500 feet upwards in elevation with a considerable diversity in soils, climate and vegetation. More strictly the term Vipya applies to areas of open grasslands of a relatively dwarf type. Owing to the configuration of the land and the direction of the prevailing winds, the greater portion of the true Vipya lies to the east of the watershed dividing the two districts—an area that is so exposed and windswept that trees do not exist except in a few hollows, whereas on the western side which is sheltered from the prevailing winds, the lands naturally consist of forest of some type, in spite of a lower rainfall, and such areas of grasslands as occur—now considerable—are not natural, but are the inevitable succession to the destruction of the forest by natives in recent times.

The actual grasslands are very undulating, and abundant clear running water occurs in every little valley, and as these valleys run in all directions in spite of the general slope of the mountains to the east, there is always some degree of shelter to be obtained from the winds which, whilst mainly eastern, vary during the year from due north to due south, via east. In the north the convolutions of the land are most pronounced, and the grassy areas are very steep, with narrow ridges, whilst as one travels south the tendency is more and more towards the development of gently undulating rolling downs on which cultivation by implements is feasible.

On the whole the grasslands of the true Vipya are very uniform in composition, there being only a minor amount of inferior tussock grass on the highest points, and the bulk of the area is occupied by grasses of a climax type, in which species of *Andropogoneæ* predominate. The dominant species is undoubtedly *Themeda triandra* which is found in several varieties. This is an excellent pasture grass, and it makes a very good hay. Whilst not so deep rooted as some other species, it is most important in lessening soil erosion, as its dead leaves tend to break up into fibres

which form a spongy mat over the surface of the soil. It is more sensitive to the effects of bush fire than many other species, and when this factor is long continued, it becomes invaded by other species of lesser agricultural value, and becomes gradually suppressed.

Among species which occur mixed with the dominant *Themeda* or which form almost pure stands at times, the following may be mentioned as having distinct agricultural value—when kept low in growth by grazing or cutting early. *Andropogon gayanus*, *A. schirensis*, *Hyparrhenia hirta*, *H. cynbaria*, *H. filipendula*, *Monocymbium cereesiiforme*, *Heteropogon contortus* and *Exothea abyssinica*. In the hollows near water, and fringing the small clumps of trees various tall and very coarse *Andropogoneæ* occur. There is a remarkable paucity of panicoid species of such genera as *Brachiaria*, *Digitaria*, *Paspalum*, *Urochloa*, *Echinochloa*, *Panicum*, *Pennisetum*, *Setaria*, etc., which goes to prove the long period during which the Vipya has existed as a climax grassland, the species of such absent genera being generally ruderal, i.e., growing in waste places during the transition from cultivated forest lands to permanent grasslands. There are but few species of *Eragrostis*, and *Chloris virgata* is far from common.

There is unquestionably an abundance of excellent grazing grasses on the Vipya, yet the area has a bad repute among natives. How far this is due to moving thereto cattle from low levels, which thus fail on account of exposure to cold, and indicates a necessity for acclimatisation, or how much depends on the existence among the grasses of various poisonous plants, it is impossible to say. The area was surveyed in the autumn, when the maximum number of grasses were in an identifiable condition, whereas the majority of non-graminaceous plants are vernal, and in autumn are hidden by the rank growth of grass. There is need for a detailed ecological survey of the flowering plants other than grass during the spring, when they are in evidence, as many of them can be economically important in the wrong direction. It is possible that cattle have been taken on to the Vipya for the spring grazing, after the fires. Grass burning tends to develop the abundance and extent of non-graminaceous plants, since their development depends on their being able to make an early start in spring, before the grass gets tall enough to stop their growth by shading them. This goes on year by year, but if grasses were unburnt, then other plants would gradually die out. Very many of the earliest species to come into growth are bulbous and tuberous plants of the *Asclepias*, *Iris*, *Lily* and *Amaryllis* family, many of which have decidedly poisonous properties, and in the absence or paucity of new grass growth, cattle may have grazed heavily on these "weeds" and got poisoned thereby.

The western Vipya as already stated is of an entirely different type, being primitive grassland, resulting from the destruction of forest for cultivation, and subsequently abandoning the land to natural agencies. The botanical composition of such areas is consequently most complex, and varies enormously according to soil type, to age, and to degree of mismanagement. With adequate protection such areas would gradually pass through various transitions to forest growth, and would not remain long in a climax grassland stage, as is the natural tendency on the eastern side of the watershed. The composition of the vegetation and the succession is most difficult to analyse. In general the grasses strikingly absent to the east are here plentiful. Annual species predominate, and perennials gradually get established. The weed flora is very much in evidence, and panicoid grasses such as *Panicum*, *Digitaria*, *Setaria*, *Tricholena* and *Melinis* are abundant, as are species of *Eragrostis*, *Chloris*, etc. Few of the grasses tend to carry over the autumn and winter in a condition attractive to livestock.

In any eventual development of the Vipya by Europeans the logical method would be to farm both the eastern and western types simultaneously. The former would be developed into a pure grazing area and by good management—principally the control of fires—the value of the grazing would steadily improve. Cultivation would be restricted to suitable portions of the western area, a part of which could be developed into grazing lands and forest. The crops would be various cereals and pulses, perhaps with tobacco in places—all annual crops. There appears little possibility of successful development however until the more tropical portions of the West Nyasa district—subsequently described—are well developed. The latter area would then provide an excellent market for much of the produce of the Vipya area. There would of course be an eventual possibility of an export of hides, wool and other animal products from the Vipya, in addition to the production for local consumption of cereals, etc.

*The Tropical Area in West Nyasa.*—This title can be applied to the whole of the district between the Lake and the 4,000 foot level, although owing to physical configuration of the land the central half of the area is of greatest economic interest to Europeans, more especially in view of the fact that some sixty per cent. of the native population is at present in occupation of lands of any value along or within a few miles of the Lake shore. In the northern quarter the land is very mountainous right down to the Lake shore, and the native population, apart from the asset of fish from the Lake, has a rather precarious existence, dependent on the cultivation of excessively steep slopes—often at a great distance—which suffer from rapid erosion owing to ignorance or laziness as far as provision of contour drains is concerned. In the southern quarter there is a considerable area of moderate quality flat lands, interspersed with numerous rivers and swamps, backed by steep stony slopes of no agricultural value. In this area a larger populace can subsist upon the products of the Lake, supplemented by moderate crops of millet and cassava, and generally good crops of rice, but both ends of the district are practically useless from the European planter's point of view.

The central portion of the district compares favourably with the more tropical portion of the Mlanje district in many respects, the rainfall being equal to that of the centre of the tea belt, with an equally favourable distribution, whilst temperatures are probably slightly higher for similar elevations. The configuration of the land is generally much less flat than that of the Mlanje tea area, especially above the 2,500-foot level, and as the majority of the natives have settled on the lower levels, as in other portions of the district, it is probably advisable to foster a continuance of this practice, gradually encouraging the minority to settle there also, as and when there is a demand for lands for European settlement in the district. From 2,500 to 4,000 feet the soils are generally deep and of medium texture. Owing to general steepness they are well drained, and



there is an abundance of clear running water in practically every valley, large and small. Cultivation by implements is almost impossible, and the lands are emphatically suitable for the cultivation of perennial crops only. To prevent erosion, contour drains will be necessary everywhere, and on some of the steeper fertile slopes, terracing would be advisable as well. To take one crop alone—tea—it will be far more expensive to establish a plantation in West Nyasa than it has been in the past in the Mlanje and Cholo districts, owing to the more expensive methods of cultivation that will be involved. As against this, there should be a higher yield per acre, owing to the freer soils, and the longer growing and plucking season, whilst the diverse elevations at which cultivation of the crop will be possible, should lead to the production of teas of higher quality. There is everywhere abundant water for driving machinery, and consequently the forest resources will only be drawn upon to provide fuel for firing the tea after fermentation.

The land is generally well timbered up to 4,000 feet or more, and *Landolphia* rubber vines are plentiful in the lower portions. The "wild ginger" *Ammomum* spp.—is rather less common than in the Mlanje tea belt, owing to the better drained and less heavily shaded soils. An interesting wild plant that occurs plentifully in one portion of the area is the West African oil palm—extremely rare in the eastern half of Africa. Judging by native gardens in existence or abandoned, the weeds including grasses are rather less noxious than those commonly encountered in Mlanje, the dwarfer creeping types being more plentiful than the tall tufted species. This distinction is helpful in results, as soil erosion will be less severe under the creeping growth. The soils would in all probability grow coffee, but the rainy season is distinctly later in commencement than in the Shire Highlands—also continuing to a much later date. As coffee appears to depend largely on good rains in October and November, when the trees persist in flowering, the possibilities of a crop being produced in West Nyasa will be small—unless the trees abandon the strict adhesion to the calendar which they insist on in the southern part of the Protectorate.

E. W. DAVY,  
Assistant Director.

## Report of the Agricultural Chemist.

Work during the year under review may be divided into:—

1. General field work and field experiments.
2. Extension work.
3. Miscellaneous analyses and investigations.
4. Cattle dips.
5. Poisons.

General field work has been largely extended into trials of numerous varieties of tobacco and more intensive fertilizer trials.

*Varieties*: Gold-leaf, Cash, Western, Melton, Yellow Mammoth and Madole are the only varieties which are considered worth growing and selecting in Nyasaland. Fertilizer trials should be carried out year by year with standard varieties such as these.

The so-called Hickory Pryor is grown in Nyasaland on very few acres indeed (see Annual Report, 1927). It will be some time however before the reputation of the large quantities of tobacco sent home during the past few years, of which much still remains unsold, is dissociated from the name of Nyasaland and Rhodesian tobacco. It seems that there are areas where the standard varieties mentioned cannot be grown successfully. A country may only produce a thin cigarette tobacco lacking in oil and elasticity and whose rate of burn is rather fast, but the future of tobacco growing as a part of that country's permanent agriculture is uncertain. Such tobacco can only be used as a small percentage in blends.

*Seed*.—Some 500 lbs. of seed of standard varieties was produced on the Zomba station. Many pounds were disinfected, including the supply of the Native Tobacco Board. Western (Dark Nyasa) developed and selected on the Zomba station is the variety now almost exclusively grown in the Central Province by natives.

Certificates of seed production were issued to approved seedsmen.

*Fertilizer Trials*.—There is much need of help in this connection, especially in the field at harvesting and curing time. The fertilizers most studied are highly concentrated, as these are the ones likely to be in use in Nyasaland owing to heavy transport charges. Such are found in the following list with the prices paid per long ton:—

	£	s.	d.
Diammonphos 21% N, 53.4% P <sub>2</sub> O <sub>5</sub> ... ..	92	17	0
Urea ... ..	33	12	8
Nitrophoska 16½-16½-20 ... ..	23	16	6
Nitrate of potash ... ..	30	0	0
Precipitated bone phosphate ... ..	16	0	0

This gives unit values at Zomba of 6s. 8d. for soluble phosphate, 14s. 8d. for nitrogen as in urea and 6s. for soluble potash, which compares favourably with those in Salisbury, Southern Rhodesia (see R. Agric. Journ., Dec., 1927).

In these field experiments it is essential to have as many as eight replicates of each treatment, otherwise the result may have little significance. Weighing a number of yields of small plots as soon as the leaf is harvested will give information as to increase in yield, but the only information as to quality can be obtained if the leaf is cured separately, and as yet the accommodation is hardly sufficient for curing and keeping the products separate.

A number of deductions can now be made, but statisticians may say that results have little significance as to quality. The deductions are supported by field trials carried out on estates throughout the country the results of which have been published from time to time.

During the year co-operative work was instituted with Messrs. The African Explosives and Industries, Ltd., largely at the instigation of the Assistant Director of Research, Nitram, Ltd. Samples of soil collected from the main types of the soil series as classified by myself in Nyasaland were forwarded to their laboratories. The general deductions from these samples supported my earlier work (see Bulletin No. 2 of 1924, Bulletin No. 1 of 1925) thus:—

*Likangala series*.—Very low total phosphates with a high proportion of "available" phosphates. Generally low potash. Soils are not sour, although in certain seasons on the sandier types sand-drown is seen, to prevent which small applications of ground magnesian limestone are recommended. Fairly well supplied with total nitrogen for soils on which flue-cured tobacco is grown. Content of total lime and magnesia is low.

*Tuanjati series*.—Very high total phosphoric oxide and potash content. There is a very high "available" phosphoric content. Tuanjati soils are somewhat sour although containing very high total lime content but sand-drown also likely on sandy soils.

*Cholo and Zomba road high elevation soils*.—Low total phosphate content but high "available" portion. High total and "available" potash. High percentage of nitrogen in shallow heavier soils newly opened. Soils slightly sour with low total lime.

*Malowa* (a small unimportant series).—Fairly high total and available phosphate content. Low potash content and soils are not sour.

*Namwera soils*.—Somewhat similar to Zomba road (Ntondwe) soils at an elevation of 3,000 ft. Dark tobacco soils generally on analyses.



*Mlanje Tea soils.*—Somewhat sour soils as recommended in N. E. India for tea. Available phosphoric acid low. Proportion of total potash, lime and magnesia generally low. High nitrogen and organic matter content in the deep soils sloping away from the mountain massif.

To commence with the phosphates on these soils, there is generally required a certain amount in a fertilizer mixture for tobacco, even on those containing a high "available" content, as the total is generally so low and our experience points, after a few years of cropping on most of these soils, to an increase in the ratio total: available phosphoric oxide. Phosphates applied maintain the total at a fair figure as required after American experience.

On the Tuanjati, Michiru and Vua soils we have yet to see any results from applying phosphates, although planters in areas in which these series occur may include a small amount of phosphates in the ridges so that prevention of phosphate starvation will then be doubly ensured.

Large applications of pure lime are likely to be detrimental on any of these soils for tobacco and tea, but small applications of ground limestone containing magnesia as recommended in Bull. No. 2 of 1925 are likely to be of benefit especially on the sandier types where sand-drown has been seen. It seems that the point sand-drown is often unduly laboured, but my opinion still is that excessive rainfall at a critical stage of growth may on certain soils lead to shortage of available magnesia. It must be remembered that the leaves of a tobacco plant may attain the normal size and shape, even when the plant is suffering from sand-drown, and although only a few bottom leaves give us any indication of this, there is produced in certain seasons from such plants leaf which is lacking in body and elasticity.

It has been seen that side applications of muriate of potash and salts containing magnesia have done much good during certain seasons on sandy soils.

A word may be said about lime or calcium deficiency. Many samples of Nyasaland tobacco have shewn a much smaller percentage of lime than that in American flue-cured. Lime deficiency is most pronounced in the bud or top leaves of a plant. The leaves as they are unfolding from the bud become diseased, and as they grow their tips and margins show abnormalities in the shape. In extreme cases the death of the terminal bud or growing point is the result. Under field conditions when the element calcium is deficient growth is markedly reduced. Now while lime deficiency has been rarely seen in Nyasaland, we consider it unwise that large applications of fertilisers which are lime robbers should be made to most of these soils, and furthermore the small percentage of lime in leaf tobacco, even from the Tuanjati and Vua soils, points to the desirability of small dressings of magnesian lime unless the cost is particularly excessive.

Such dressings should be included where ammonia and potash sulphate and chlorides are applied in quantities, these being noted as lime robbers (see later).

It may be that the aroma of Nyasaland tobacco will be shewn to be improved by applications of lime. I fail to see however how large applications of chlorides would be either beneficial in this respect or even economically possible, and as has been said lime in proportion must be applied with such large applications of these salts, which would make fertilizing an unprofitable matter.

Potash starvation of tobacco is rarely seen on these soils but small applications have been shown to maintain the plant's vigour and, as pointed out for the Likangala soils series, it gives considerable resistance against leaf spots and other disease. Applications are here required smaller than those generally applied on American flue-cured tobacco soils, and these may be derived from the muriate. No beneficial results from applying sulphate of potash beyond conveying disease resistance in certain seasons and a slight improvement in texture has been seen in Nyasaland. An excessive amount of chloride in fertilizers for tobacco injures its growth, producing a thick brittle leaf, and also has an unfavourable effect upon its burning quality. It is unlikely that applications of more than 60 lbs. per acre, which are sufficient to cause this, will be made in Nyasaland, and 25 lbs. per acre are often enough, as in dark tobacco areas of Tennessee.

Potash in fertilizers for sandy soils should be in a larger percentage than the nitrogen. Average applications of potash to Nyasaland soils do not delay ripening of tobacco.

It is easily understood that there are optimum applications of fertilizers for different conditions, but such rates can only be ascertained within very wide limits for Nyasaland conditions. At any rate the large applications of American flue-cured tobacco growers will not be profitable in Nyasaland. Such large applications may be conducive to disease or the increased yield obtained with them may give a higher yield of coarse tobacco, which may not be as valuable as a lower one obtained with fertilizing at a smaller rate or with better balanced fertilizer.

A word may here be said about the nitrogen for tea and tobacco soils. The highest yield of tobacco from the Western variety was obtained from plots fertilized with magnesian lime at the rate of 600 lbs. per acre and a side application of sulphate of ammonia at 50 lbs. per acre. This yield of 1,400 lbs. per acre as compared with 1,192 lbs. per acre of cured leaf on unlimed plots was from newly-opened land in a dry season. Now as the value of results of analyses of soils have been grossly exaggerated in Nyasaland, it may be as well to point out that it is practically impossible for an analyst to say of certain soils on the information given by an analysis of total or "available" constituents, whether lime, magnesia, sulphur, or nitrogen starvation of tobacco or other crops will occur under certain climatic conditions. (These elements were all supplied on the limed plots.) The symptoms of such starvation are now well known, and whether such phenomena are likely must be judged by observers who have long experience of the soil series under consideration under many climatic conditions.

The form in which *nitrogen* should be applied to tobacco land is of importance. In any one season one planter prefers nitrates to ammonia compounds, while his neighbour considers that compounds of ammonia are superior to nitrates. Generally speaking such observations are worthless; many do not know the difference in action between nitrates and ammonia in the soil.

There is no reason to think that in our high rainfall areas that side applications should be dispensed with. It was laid down in 1921 that all soluble nitrogen should be applied in a side application up to twelve days after planting out, but I now consider that on older land some, preferably in the form of a compound of ammonia, should be applied before planting. What proportion or in what form the side applications should be, must be considered in the light of the following facts, but it is maintained that about one-quarter of the nitrogen should be derived from nitrate of potash applied after planting.

1. For soils containing a fair total nitrogen content, there is a varying nitrate content at the beginning of the rains depending on:—

(a) time and efficiency of cultivation;

(b) time since it was opened out from virgin bush.

In the first year, aeration is rarely sufficient. The maximum nitrate content is usually found in the second year, and the available nitrogen decreases from the third year.

(There seems to be from recent estimations a rapid increase in available nitrogen at the beginning of the rains as soon as the soil is wetted, and bacteria start into full activity with the spring conditions. This nitrification varies in rate with the age of the soil.)

2. Nitrates are easily removed by heavy rains, so that at the end of fourteen days a down-pour of ten inches in that period may have reduced the nitrate to the minimum for maintaining growth. It is now that side applications are so beneficial. Compounds of ammonia on the other hand are fixed by the soil and are liberated in the nitrification process.

Experiments on the Matiti seed station, run during the year in conjunction with Messrs. Blantyre and East Africa Limited, attempted to give the following data in the year under review:—

(a) The correct time of application of urea before planting and to plants in the field.

(b) The availability of nitrogen in nitrate, urea and diammonphos.

(c) The relative value of muriate, sulphate of potash and double manure salts with and without applications of magnesia lime.

(d) The availability of phosphoric oxide in double superphosphate, precipitated bone phosphate and steamed bone flour.

It is impossible in the year on this newly-opened land to say anything definite.

The production of synthetic farmyard manure by means of ADCO was carried out on the Zomba station and at the White Father's Mission, Dedza, and good results obtained.

To sum up the conclusions, with which Messrs. African Explosives and Industries, Limited, agree, I consider that the medium applications of plant food in soils of medium fertility should be as follows:—

For flue-curing:—

				lbs. per acre.		
				P <sub>2</sub> O <sub>5</sub>	N <sub>2</sub>	K <sub>2</sub> O
Tuanjati and similar average sandy loams	...	...	...	14	18	27
Likangala and similar average series: average sandy loams	...	...	...	30	15	24
The nitrogen may be decreased for the more fertile chocolate loams and increased for sandier type.						

For dark tobacco:—

Tuanjati and similar heavier soils	...	...	...	—	15	18
Cholo and Zomba road medium red loams	...	...	...	32	20	10

It is becoming increasingly certain that some of the nitrogen on poorer soils must be derived from organic materials. In certain cases it must be left to the judgment of individual planters on account of the following opinions as to whether the fertilizer is applied before planting or as to the proportion of nitrogen applied after planting.

One planter says that labour is insufficient for applying fertilizer to plants in the field, and he prefers to drill the mixture on American principles in the row before final ridging up for planting. Another will say that if he applies all the fertilizer before planting he may gain little profit from fertilizing, because he may not be able to get a good stand owing to cutworm or insufficient nurseries, or he may lose much of it by extensive soil washing. Root gallworm also may ruin his crop, having come from late nurseries where plants may be eleven weeks old.

In these circumstances, then, we can only give general principles on the subject of fertilizing of tobacco on which the manufacturers must make up the mixtures to suit individual needs. This applies also to tea manuring.

*Field work.*—A broad classification on the basis of Dr. Ramann's work has been started.

As would be expected from a study of the rainfall map in Nyasaland, non-lime-accumulating soils are generally distributed although in a few areas lime-accumulating soils (Pedocals) are found in areas where the effective annual rainfall is below 30 inches.

The Shire Highlands are distinguished by the preponderance of red loams, immature red loams and occasionally grey-brown earth on hill sides. Ferruginous red loams with iron crust often exposed on surface are found in the plains with a lower rainfall in most parts of the Highlands, especially in the Likangala, Chilwa-Tuchila and Lilongwe plains. Lateritic loams are found notably in Cholo and Mlanje, and laterite, as shown by bauxitic earths, are found on the top of Zomba and Mlanje mountains. Tropical black earths have been found in many places at lower elevations. Layers of lime concretions may be as deep as six feet.

Total analyses of horizons of many samples of these main soil groups are necessary. The extension now put on to the laboratory in Zomba may soon make this possible. The soil series previously mentioned belong to the above main groups.



A further point about the Likangala series may here be mentioned. The soils belong to those found all over the tropics known as ferruginous red loams. That is to say, at a depth of from three to six feet a crust or layer of concretions of lateritic iron compounds are formed which is often exposed on the surface by soil erosion, or for the same reason lies but a foot or so below the surface. After a few years in cropping, this crust may become so impermeable to water that water-logging becomes another serious factor in determining low yields of tobacco. The soil temperatures are kept low in saturated soils also. It may be that in rotations for soils such as these ferruginous red loams, that after some years in cropping the field may be allowed to go back to scrub and grass assisted by deep-rooting leguminous crops such as nandolo for a few years so that the pan may be broken up (see Bull. No. 2 of 1924).

*Disease.*—During the year there was little disease on tobacco on the Matiti and Zomba stations, frog-eye (*Cercospora nicotianae*) being mostly seen. Root gallworm did some damage on one plot.

A few plants exhibited symptoms of "hollow-stalk" which is caused by *Bacterium carotovorus*. A serious outbreak elsewhere was observed which was primarily due to heavy rains during and following topping and suckering operations. This slimy rot of the pith—capable of doing considerable damage also in barns which have been filled with infected leaf—has become popularly known as stem-rot in Nyasaland. This is unfortunate, as stem-rot is usually restricted to those diseases caused by *Rhizoctonia solani*, *Sclerotium rolfsii* and *Pythium* species, isolated examples of which were seen during the year.

There was a serious outbreak during the year on ferruginous red loams with poor drainage of a disease which had all the characteristic symptoms of the black-shank of Florida. Fields were apparently planted with disease-free plants, and it was only when the plants had reached a considerable size that the symptoms were observed. A few plants were seen attacked with a very similar disease the previous year on fields where the disease was serious, and it seems that the original infection came from a nursery on one estate from which plants had been obtained for the fields in question in 1925 and 1926.

As the loss in this drier season of 1928 had reached serious dimensions, and as I had seen the serious loss in Florida from the disease which was found to be caused by a very similar organism, I took every opportunity in the absence of Capt. Smee of obtaining information concerning this disease which I proposed to call *Pythium* Black-shank. Dr. Butler's report on tobacco disease came out during the later part of the year in which he describes this disease as caused by *Pythium aphanidermatum* and names it *Black Stem-rot*. He agrees with me that the control measures of importance are similar to those recommended for Black-shank caused by *Phytophthora nicotianae* in Florida.

That the latter disease is reported in Uganda is a serious matter and makes it impossible to exclude the danger that we may have both diseases in Nyasaland.

#### EXTENSION WORK.

At the request of several planters, a comparison of climate and soil in potential and present tea areas of Nyasaland, together with manurial and cultural methods of tea, has been made with those in north-east India and a circular is being prepared.

During the latter part of the year I took over advisory work in connection with the government grant scheme to certain planters, and visited many parts of the tobacco-growing areas. It is apparent that methods of culture in certain cases require much improvement.

A series of articles on tobacco were contributed to *The Nyasaland Times*. I carried out the duties of Tobacco Inspector during the year.

#### MISCELLANEOUS.

Laboratory work had been very small during the past year owing partly to outside work and to the building of the extension.

The few investigations have dealt with —

(a) Normal nitrogen fixation by *Azotobacter* in Nyasaland soils, carried out by Mr. L. S. Norman, assisted by myself.

(b) Acceleration of nitrification with first rains.

(c) Base exchange in soils, chiefly lime, using 0.5N acetic acid, which method has been compared with sodium and potassium chloride exchange methods.

(d) Chlorine in Nyasaland tobacco ash and burning quality.

(e) Soap manufacture.

These call for no full report here with the exception of chlorine in tobacco.

It has been known from investigations by the Imperial Institute for a long time that the chlorine content of Nyasaland tobacco was very low. It is not generally realized that this varies according to the amount of rainfall, and although a dry year is associated with better ripening and therefore easier curing, *more desirable aroma* and lower chlorine content, there is more likelihood to be a connection between the better ripening and more desirable aroma than between the latter and the chlorine content. The potash-chlorine ratio is also found to be much greater in a wet year, which often causes the tobacco to burn too fast. A paper on the composition of the ash of tobacco samples taken over many seasons with particular reference to chlorine and alkalinity is being prepared.

It seems with the low prices now being obtained for tobacco that field applications of chlorides with the object of improving quality if the season is propitious are nearly out of the question, as in many seasons they would not have a desired and profitable effect.

*Cattle Dips.*—The manufacture of cattle dip for government tanks was continued in Zomba.

*Poisons.*—Several stomachs and contents of cattle suspected of having died of dip poisoning have been analysed. In most cases carelessness in spilling dip or disposing of the outflow on earth which was subsequently licked by the animals was indicated. The number of suspected poisons now forwarded by the Administration are reaching a large figure. Much of the above work often interferes with the normal work of the specialist in agricultural chemistry.

*Rainfall Map.*—In connection with the soil survey, a provisional rainfall map of the Protectorate has been prepared.

*Crop Relationships.*—As far as the soil survey is concerned with crop relationships, the following crops are very successful in many parts of the Protectorate, and it seems a pity that the high freight charges to Europe prevent the development of a diversified agriculture with high yielding crops in such fertile areas of South Eastern Africa.

(a) Oil-Seeds.—Castor oil, Sunflower, Sesame, Groundnuts, Soybeans, Mafoureira (*Trichelia emetica*) giving a bean containing 60 per cent. of oil suitable for soap making grows well in many parts of the country.

(b) Sorghums: The sugar sorghums are being grown in Zomba, and machinery has been obtained for the manufacture of syrup.

(c) Essential Oil Plants: Geranium sp., Citronella grass, Camphor, Wormseed, etc., present little difficulty in most high and middle elevations of the country.

(d) Tea may yet prove a success, perhaps as a native crop, on the slopes of Zomba mountain with and without irrigation. The figures for climatic conditions at Ranchi, Orissa, do not show such promise as those for Zomba, and yet 2,000 acres are grown there. *Calotropis gigantea* has grown well up to 3,500 feet above sea level at Nyungwe, Blantyre. It may be said to yield gutta percha from the milky sap; a strong fibre from the bark; a useful floss from the seeds; and a medicine from the root-bark. I should however be very unwilling to recommend anyone to invest money in this crop, although so many promising articles have been written concerning it.

A. J. W. HORNBY, B.Sc., A.I.C.,  
Agricultural Chemist.



## Report of the District Agricultural Officer, Fort Johnston.

The work for the year 1928 has been a continuation of that carried out in 1927, details of which were contained in the Annual Report for that year.

*Meteorological.*—The rainfall for the season November 1927 to May 1928 was 21.54 inches. There have only been three other seasons so dry in the last twenty years, viz.: 1912 with 17.24 inches, 1919 with 20.87 inches, and 1924 with 19.96 inches. The drought was practically continuous, for when rain did fall it was in negligible quantity only.

*General.*—The year was a bad one for native food crops, especially those on the flats of the Lake shore and the basin areas of Lake Malombe. In many instances the crops in their earlier stages of growth were completely lost, whilst yields of maize and sorghum were in the main but light. However, the cereal crops in the hill country were fortunately more ample, and with a considerable extension of the fishing industry on both Lake Nyasa and Lake Malombe a lively trade in bartering fish for maize and other foodstuffs developed. This alleviated the shortage very materially.

During the year I travelled extensively throughout South Nyasa and a portion of the Liwonde district, lecturing to natives on general agricultural practice and making at the same time a strong endeavour to stimulate their interest in cotton growing, while not omitting to emphasize foodstuff production as a first necessity.

*Cotton.*—Eighty-five more gardens were under cotton than in 1927, but the drought accounted for considerable losses and light cropping. So far seed issues for the season 1928-29 promise extension of areas under the crop. The seed is being distributed at the following four centres: Malembo on the south-west arm of Lake Nyasa, Nkata's in East Malombe, Changali's in West Malombe, and Kalembo's in the Ulongwe area of the Liwonde district.

*Sorghums (Mapemba).*—With a view to improving the acre yield of this on the lower levels, seed selected by myself was issued free to natives, but seasonal conditions being adverse the outcome was not as good as might have been expected. The natives as a whole did not make the best use of it, but where they did plant and care for it the results far exceeded those from their own seed. Average heads picked at random from these gardens were half as large again as those grown from unselected seed in gardens nearby, and the grains from the latter heads were inferior in size and grade to those grown from the selected seed. Average specimens of both collected from a native's gardens were duly submitted to Government as an example of the degree of success met with in attempting to improve this indigenous cereal. Arrangements were made for specimens to be exhibited to natives coming to pay hut taxes.

Further seed was again selected and issued with a view to improving the quality and standard of a foodstuff so valuable from a native's point of view, and there was certainly an increased demand for it. The larva of a lepidopterous stem-borer, *Buseola fusca* or a species near to this, did extensive damage to sorghum on the lower levels of the South Nyasa district by hollowing out the cane, and so impairing the production of seed.

*Maize.*—Seed of Potchefstroom Pearl maize was distributed in the district with a view to improving the grade and yield of that grown by the natives.

*Echinochloa frumentacea*, known to the Yao people as "Chindumba."—An endeavour was made to popularise the cultivation of this exceptionally hardy and heavy-yielding crop. As evidence of its value it may be stated that at the experimental plot at Mtumbwasi the yield was 1,000 lbs. per acre and at the Mbaluku experimental plot no less than 1,400 lbs. to the acre.

*Groundnuts.*—The Lake shore levels of South Nyasa being for the most part eminently suited to this crop, it is gratifying to report from personal observation that the culture is becoming increasingly popular with the native, more especially as the local demand seems likely to increase owing to the opening of a local factory for the manufacture of soap. Whereas at the present high rates of freight it would be impossible for a paying export trade to spring up, this development may open up a comparatively unexploited field for native husbandry. Under instructions from the Director of Agriculture, I met the District Commissioner, Liwonde, with a view to discussing the potentialities of his district for this crop. In a series of native-owned gardens averaging 0.279 acres the yielding worked out at 912 lbs. unshelled nuts per acre.

*Rice.*—There was a tendency for more rice to be grown. Computed yields of 924 lbs. of unhusked rice to the acre were obtained from native-owned gardens, averaging 0.205 acres, situated on the banks of the Shire river.

*Experimental Work.*—For this work two experimental plots each comprising five acres are in use; they are situated within two and a half miles of Fort Johnston and on the east side of the river.

Trials of varieties of groundnuts at Mtumbwasi plot:—

Variety	Yield per acre 1928	Average yield per acre over three seasons
Spanish Bunch		
Chimwila (Zomba-Naisi) ...	1,120 lbs.	967 lbs.
Nteza wenandi (F. J.) ...	1,040 "	1,140 "
Basse (imported from the Gambia) ...	1,020 "	—

The Spanish Bunch variety was only tried out once here 1926, when it yielded 770 lbs. per acre. It is included in the comparative trials for this season. The Basse variety has shown promise in its first year of trial.

*Maize.*—The comparative trials of Potchefstroom Pearl maize against the local native "Mkozi" was hardly a fair one, owing to the fact that the former gave exceedingly low germination which necessitated re-sowing. Fresh seed had to be procured, and by the time it had

arrived three weeks had elapsed, during which time the native variety had had the advantage of three and a-half inches more rain—a marked advantage in a season of drought conditions. The experiment is being continued this season.

*Cassava*.—The six varieties of this crop which I introduced from North Nyasa yielded in single plot trials as follows:—

Variety	Period of growth	Yield per acre
"Muuyu" ...	Eight months	9,600 lbs.
"Chitekambwani" ...	" "	8,160 "
"Kachamba" ...	" "	5,120 "
"Kamarasu" ...	" "	4,240 "
"Bitiasumani" ...	" "	1,200 "
"Tipula" ...	" "	nil

The variety known as "Tipula" did very poorly indeed. Unfortunately no yields were obtained as the plot was devastated by wild pig. The effort to establish this more generally amongst the natives was continued, and further issues of cuttings in quantity were made.

*Pumpkins*.—Through the interest of a friend in North Italy I was able to obtain for experimental cultivation the seeds of a pumpkin held in high esteem by the Italian peasantry. These were planted in August and duly fruited in October and November. The plants make luxuriant creeping growth, with trailers twelve to fifteen inches in length. The fruits, which may be thirty inches long and five inches in diameter, may weigh as much as fifteen pounds. They are a very pleasant article of diet, and most certainly have good storing qualities. They have an additional advantage in that when cut they remain good for several days. Seeds were matured, and a few distributed to selected natives. Every effort will be made during the coming season to cultivate a sufficiency for the widest possible distribution. With a view to stimulating interest in the introduction, parties of natives were shown the fruits.

*Fruit-tree nurseries*.—In these nurseries there are still a considerable number of seedling fruit trees, particularly of papaw and mango, and in smaller quantity lime, lemon and mulberry. Peach seeds have been planted, and this would seem to be a fruit tree that should be appreciated, since these, at least, do escape the ravages of the all-devouring goat. It is to me a matter of regret that natives cannot be persuaded in their own interest and especially those of their children to take these away for planting in their villages.

*Tobacco and Rotations*.—Work on the Mbaluku experimental plot proved abortive owing to shortage of rain and the long periods of drought experienced. It is hoped that the season 1928-29 will be more favourable to the work in hand.

*Cotton*.—On this area, strain "B," a selection by the Empire Cotton Growing Corporation, returned 610 lbs. seed cotton to the acre.

*Mucuna lyonii* ("Kalangonda" bean) grown in lieu of soybean, seed of which was not available, yielded at the rate of 1,245 lbs. shelled beans to the acre.

*Poultry improvement*.—The disease "Chitopa," an affection of the alimentary tract well known to the Veterinary Department, caused heavy losses amongst the pure-bred birds which were issued by the department for crossing with the native breed; nevertheless progress was made. During the year nine more Rhode Island Red cockerels and ten pullets were put out into the villages. As evidence of the value of this scheme it may be remarked that at the show of the Agricultural Society of Nyasaland this year a special prize was awarded to a native who exhibited a half-bred cockerel and pullet which he had bred from one of the Rhode Island Red sires.

*Seed issues*.—Free issues to natives were again made this year to the following extent:—

Maize (imported) ...	2752 lbs.	...	330 issues
Sorghum (selected) ...	1140 "	...	120 "
<i>Eleusine coracana</i> (finger-millet) ...	70 "	...	44 "
<i>Echinochloa frumentaceae</i> (chindumba) ...	260 "	...	...
<i>Manihot utilisima</i> (cassava) ...	3750 cuttings	...	...

Owing to the food shortage, which I had anticipated, it became necessary to supply secondary crop seed, and on my recommendation the following were obtained and distributed:—

<i>Phaseolis vulgaris</i> (Canadian wonder bean) ...	871 lbs.	...	601 issues
<i>Cucurbitaceae</i> (pumpkins, etc.) ...	168 "	...	877 "

*General*.—If the food situation is to be less mercurial in the future than it has been in the past it will, in my opinion, be necessary to try to influence the native to use greater selection than hitherto in regard to his main food crops apart from maize. It is sometimes almost pitiful to observe how often the native, with the faulty agricultural tradition inherent in him, struggles to produce, under conditions wholly unsuitable, a small amount of a particular crop for which he has an especial liking, when others of equal value but more suited to his soil and climatic conditions would return almost more than his requirement. Thus for instance I have repeatedly observed poor sorghum in gardens where cassava would flourish exceedingly, and on far less labour.

There is a lamentable lack of rice production in the Lake Malombe area where the people struggle with sorghum (probably because they are as yet unaware that a brew still more potent than their "moa" can be brewed from the crop). I have endeavoured during the past year to impress the necessity for more judicious selection in this direction on the minds of many whose gardens I have inspected, though, so naturally conservative is the average native, I am very doubtful of any result.

During the year I collected considerable material for the Herbarium of The Royal Botanic Gardens, Kew. It is gratifying to note that from amongst them two specimens of sorghum were determined as new to science. It was further most interesting to learn that a specimen of cereal termed by the Yao people "Chindumba" (*Echinochloa frumentaceae* Link.), which is largely cultivated in India, has hitherto been unknown from tropical Africa. The Kew authority on African millets was especially glad to receive no fewer than eight forms of the finger-millet *Eleusine coracana*, Gaertn.

FRANK BARKER, District Agricultural Officer.



## Report of the Empire Cotton Growing Corporation.

*Introduction.*—The main feature of the work at the two stations—Makwapala and Port Herald—has been the clearer realization of the Jassid problem in Nyasaland. The relatively severe attack of this pest has resulted in the elimination of doubtful strains in the breeding plots, and the comparative failure of the Foster-Whitehall "G" strain at Port Herald has emphasized the weakness of a jassid susceptible strain under conditions suitable to the development of the pest.

Apart from the experimental stations, a considerable number of test plots, mainly of Over-the-Top "B," have been grown, both by natives and Europeans, with satisfactory results—the average yield of these plots all over the country being 400 lbs. seed cotton per acre. The maximum yields obtained have been 200 lbs. and upwards of lint per acre, and this, compared with the yields obtained with the local variety, is very gratifying.

### MAKWAPALA COTTON STATION.

*General.*—The working of the station has continued on the lines of the previous season. The buildings have been augmented by the addition of two tobacco barns and a grading shed to deal with the tobacco grown in the rotation scheme of the station. In view of the desirability of having a labour supply resident on the station native lines have been erected.

Various implements have been added to the equipment of the station, these being of a type strong enough to stand up to the work of cultivation, and yet sufficiently light to be worked with one pair of oxen. Among these an all-metal plough—Ransomes Sabul—has proved of particular value. The whole area has now been ridge-terraced, and apart from minor details the question of soil erosion on the station has been satisfactorily dealt with.

With regard to the rotation crops, the rotation scheme was carried into the fourth year, and the only feature of interest was the complete failure of *Dolichos lablab* to crop, owing to the attack of insect pests—a Chrysomelid and a Bruchid beetle. The important point of this season's observations is that all indications point to the system of rotations being adequate to control Bollworm sufficiently to permit of a reasonable yield of cotton being made. The fundamental difficulty is likely to be stainer and its control.

*Field Experiments:* The series of spacing experiments, "Ridge and Flat" experiment, and variety trial, were repeated from the previous season. The results of the previous experiments were somewhat inconclusive, and the plot layout was modified this season to suit ridge-terraced land, and the number of plot replications was increased.

*Spacings Experiment:* The trial spacings ranged from 4 ft. by 2 ft. (2 plants) to 4 ft. by 6 ins. (1 plant) with a standard 4 ft. by 2 ft. (1 plant). The more dense spacings, 4 ft. by 1 ft. and to a slightly lesser degree 4 ft. by 6 ins., showed a significant yield superiority to the standard. From this it would appear that a somewhat more dense spacing than has been hitherto used would be of advantage.

*Ridge and Flat Experiment:* The variety grown was Over-the-Top B and the spacing used was 4 ft. by 2 ft. (1 plant). The ridged plots gave a significantly higher yield than the plots planted on the "flat." The ridged plots cropped earlier, and under this season's conditions the evidence is strongly in favour of an early crop being best, both in amount and quality. As was noted in the spacing experiments, the highest yields were obtained from the denser spacings, which were earlier in crop, and it would appear that increasing the plant density and forcing the crop to earlier maturity by ridging are cultural methods of value to the cotton grower.

*Variety Trial:* The trial made last season between Over-the-Top "B" and Nyasaland Upland was repeated. The Over-the-Top showed a superiority in yield, and it is considered that this is due in some measure to its superior resistance to jassid.

*Plant Development Records:* The following records were made on the centre row of each plot in the variety trial.

- (a) Flowers per plant (daily).
- (b) Bolls per plant (twice weekly pickings).
- (c) Sheddings per plant (daily), analysed into:—
  - (1) Buds and Flowers shed due to Bollworm.
  - (2) " " " not due "
  - (3) Bolls shed due to Bollworm.
  - (4) " " not "
- (d) Growth in cms--weekly.
- (e) Weekly collection, from a neighbouring bulk, of bollworm infested material and analysis of bollworm into species.

*Flowering Curve.*—As was noted last season the effective flowering period is over by the end of April. The Nyasaland Upland strain again gave a slightly higher flower production, but there appears to be no difference in earliness between the two strains.

*Bolling.*—The losses between flowering and bolling are again very high, with the Nyasaland Upland showing the heaviest loss. The most important point demonstrated by the records in the great loss of bolls through stainer damage during the period March 16th to May 15th—the two critical months in determining the final yield. During this period the loss caused by bollrots is very considerably greater than that from bollworm, and it is this high loss which was responsible for the failure of the Makwapala crop to equal last season's yields. The heavier stainer infestation this season is undoubtedly due to the heavier March rainfall and to the protracted dull, cloudy spells between March 16th and April 21st. Whether attempts at direct control of stainer by trapping or similar methods are likely to be of any use in the future is doubtful. The experiments this season indicate that an early crop has the best chance of coming to maturity.

The analysis of bollworm showed results very similar to last year, except for the marked infestation of American bollworm in March this season. If this is confirmed next season it would appear that red bollworm has been given an undue importance and that a serious loss at the critical March period is due to the American bollworm.

*Cotton Breeding Work.*—The bulk planting was again the Over-the-Top mixed bulk, and the average yield fell to 200 lbs. seed cotton per acre from the 360 lbs. of the previous year. This was due to the heavier jassid attack, coupled with the very severe stainer infestation referred to above.

A number of the most promising progeny rows of Over-the-Top were bulked this season to ultimately replace the parent stock. Three of these sub-strains proved very superior to the parent bulk in their resistance to jassid, and in addition gave yields over double that of the mixed bulk. Two of these (B 30-1 and B 30-13) have been selected for further bulking next season. It may be noted that these sub-strains have a longer lint length than the mixed bulk.

A large number of selections from the previous year were grown as progeny rows, augmented by importations of U 4 and A 12 from Barberton and Improved Bancraft from Rustenburg. The work of selection was simplified by the failure of everything except the Over-the-Top and Barberton strains to resist the jassid attack.

*Insect Pests.*—In addition to the work described under "Plant Development Record" several of the insect pests were studied.

*Stainer (Dysdercus sp.)*: An attempt was made by means of a series of cotton seed traps surrounding the station to determine the source and incidence of the stainer invasion. It was noted that the general direction of the immigration was from the south-east, and this is the direction from which the wet season winds come to Makwapala. Stainer was first seen about mid-February and by the middle of March the infestation was heavy. No host plants were discoverable near Makwapala, but it is known that Baobab and Sterculia sp. occur on the Palombe plain, and it seems possible that the invasion may start from these host trees. The areas where these occur are lower and more humid than Makwapala, and would make admirable over-wintering sites for stainer.

*Jassid*: Weekly counts of jassid nymphs were made on plants of the various strains of cotton grown on the station. The Over-the-Top strains showed least attack with the Barberton A 12 strain next. The other Barberton strain U 4 showed a considerably larger number of nymphs with the Foster-Whitehall strain showing the heaviest attack. Hair counts were made on sections of leaves of the above strains with a view to determining the relation between the hair density and severity of attack. It was found that the hair density was roughly in inverse ratio to the jassid attack.

#### PORT HERALD COTTON STATION.

*Introduction*: The layout of the station was described in the report of the previous season, the only change being the clearing of a small additional acreage on which to grow small observation plots of potential rotation crops. The rotation scheme of the previous season was carried on into the second year, but in view of the need for more acreage for cotton-breeding work, it has been decided to modify the scheme to some extent. Half the acreage will be devoted to cotton and the other half divided equally between cereals and leguminous crops, this giving a four-course rotation, with cotton occurring twice.

The planting of trees was continued along the station boundaries and around the buildings, and Napier Fodder grass planted round the field borders.

*Season*: The season was fairly satisfactory as far as the cotton crop was concerned, though a long hot dry spell after planting caused some mortality among the young seedlings. With the rotation crops the position was very different, as the long hot and dry period from the middle of January onwards had a serious effect on the food crops of the district—the cereals in particular being very poor.

*Field Experiments.*—A series of spacing experiments, variety trials and time of planting experiments were laid out as in the previous year, but with an increased number of replicates.

*Spacing Experiment*: Foster-Whitehall strain G, which was the ordinary bulk cotton of the station, was used for this experiment, and the trial spacings ranged from 4 ft. by 2 ft. (2 plants) to 4 ft. by 6 ins. (1 plant) with the standard as before 4 ft. by 2 ft. (1 plant). The results obtained, though inconclusive, were substantially the same as in the previous season, and would indicate that a somewhat denser spacing than the standard would be of advantage. The spacings giving the highest yield were those of 4 ft. by 6 ins. (1 plant) and 4 ft. by 2 ft. (2 plants).

*Variety Trials*: Two series were laid down, using the same plot layout as before. The varieties used were Foster-Whitehall strain G, Over-the-Top B and a Nyasaland Upland strain V which was used as a standard. The results showed a yield superiority in favour of strain V.

*Plant Development Records*: The following records were kept on the middle row of each plot in the variety trials:—

- (a) Flowers opening (daily).
- (b) Bolls opening (weekly pickings).
- (c) Bollworm infestation (all bollworm infested material removed daily and analysed into (1) Buds attacked (2) Flowers and bolls attacked).
- (d) Growth (weekly).
- (e) Weekly collection and analysis of bollworm into separate species.
- (f) Weekly collection and analysis of shed material.

The flowering records of the three strains was substantially the same, and in no way accounts for the differences in yields as evidenced by the bolling records and by the final yield figures. Table 1 gives an analysis of the yields of the three strains.



TABLE I.

Strain		Number of flowers per plant		Bolls picked percentage of flowers		Loss by bollworm per cent.		Loss by other causes per cent.
"V"	...	52.5	...	40.6	...	32.8	...	26.6
"B"	...	53.5	...	34.7	...	34.7	...	30.6
"C"	...	51.5	...	32.5	...	34.4	...	33.1

It will be noticed that strain V suffered less loss through Bollworm and decidedly less loss through other causes, and it is apparent that this latter factor has been the more important in deciding yield superiority. No natural shedding of bolls was observed, and non-bollworm loss is attributed to insect-carried bollrots.

*Cotton breeding work.*—In all about eighty progeny rows were grown this season comprising a range of selections of Over-the-Top A and B, Foster-Whitehall C and H; Arizona N and Z, which were carried on from last season. To afford a wider range for selection, various importations were added. These included Cambodia types from Gatooma and two small bulk—U 4/5 and A 12/2—from Barberton. Jassid attack on the station was pretty severe, and the selections were put to a good test which facilitated the work of selection.

The Cambodias, though highly resistant to jassid, were in the main too vigorous in growth, and their denseness coupled with lateness and lax habit provided harbourage for stainer. On account of their jassid resistance and high productivity these Cambodias are a valuable addition to the station seed stocks, and several of the more open and less lax types have been selected for further observation. Of the Foster-Whitehall strains, G was on the whole a failure on account of jassid, but the H strain proved fairly resistant and was prolific. The Over-the-Top selections showed little evidence of jassid attack but were much attacked by bollrots and disappointing in yield, while the Arizona N and Z, afforded little material for selection.

The two importations—U 4/5 and A 12/2—gave some promising selections as regards resistance. Both types were early and prolific with the U 4/5, on the whole, superior. A large number of selections were made, and these, together with selections of Nyasaland Uplands from various localities, should provide a useful range for the coming season. Seven of the progeny rows from the previous year were bulked for observation.

Table II gives the characters of the plots.

Strain		Yield per acre		Stand percentage		Lint Length mm.		Ginning percentage
H-3-2	...	710 lbs.	...	40	...	29.5	...	33.2
H-2-2	...	1224 "	...	49	...	28.6	...	35.2
H-3-8	...	775 "	...	43	...	28.9	...	29.8
26G-35	...	485 "	...	61	...	28.5	...	34.3
26G-48	...	437 "	...	71	...	28.4	...	36.2
G-15-8	...	467 "	...	54	...	27.8	...	32.6
G-1-7	...	358 "	...	67	...	28.0	...	35.8

The selected bulks of strain G showed very little higher resistance to jassid than the mixed bulk, and will not be carried on. The H strains were fairly resistant, and in spite of poor stands gave high yields, and these will be tried out as the main bulks of the station next season.

*Insect Pests.*—(a) Bollworm: The three types of Bollworm—Red, American and Spiny—were present right from the beginning of the season. The numbers of Spiny Bollworm were inconsiderable and the attack of the American type though considerable is confined to the early bolls, as by the middle of June few larvæ of this type could be found. The Red bollworms, though present all through the season, decreases greatly in numbers by the end of June, and thus presents much the same problem as the American. In dealing with these pests, as late planting as possible consistent with the crops requirements is to be recommended, and observations on the incidence of the pests would suggest that trap cropping with strips of early planted cotton would be of value. It is of interest that a higher infestation by American bollworm was found on cotton planted near mapira gardens.

(b) Stainer (*Dysdercus* sp.): These insects were early present in the cotton, but the really heavy infestation occurred in June and July, with a record immigration in September. Traps of cotton seed were found to be of little value in attracting the insects, and a more hopeful method may be that suggested by E. Ballard and M. C. Evans (Bull. Ent. Res. XVIII, 4, p. 405) E. C. G. C. Review, October 1928, p. 349) of providing "suitable moulting places for the gregarious 5th instar nymphs."

(c) Jassid: Jassid had been observed on the station in the previous year, but the attack reached a greater intensity this year, due to the presence of early planted susceptible strains. Strain G was used in the time of planting experiment, where the first series of plots was planted on January 1st (six weeks earlier than the normal time of planting on the station). All these early planted plots suffered badly, and the infection spread to later planted cottons near by. The yields obtained from these plots averaged about 150 lbs. seed cotton per acre, compared with yields of 800 lbs. from plots of the same strain planted at some distance from the early planted cotton. This demonstrates the possibilities of the pest as a limiting factor in cotton cultivation where conditions for its development and spread are suitable. Weekly counts of Jassid nymphs were made on various strains in the breeding block. The Cambodia and A 12 showed little infestation with the Over-the-Top and U 4 very slightly more. Durango and strain G were heavily infested with strain H intermediate in attack between these and the Cambodias, and from observation on the effect on the plants it appeared that this strain H was on the border line of safety.

*Rotation Crops.*—As has been mentioned, the season was unfavourable so far as the food crops was concerned, and little can be said of these. Of the introduction of potential crops, the most satisfactory were two species of *Canavalia*, and a purple leaf type of *Doliches lablab*, both obtained from the Imperial College of Tropical Agriculture. The bush type of *Canavalia* proved to be an excellent cover crop.

Name of District.	TOBACCO		TEA.		SISAL FIBRE.		COTTON.		COFFEE.		RUBBER.		CHILLIES AND CAPSICUMS.	
	Acres under crop.	Yield cwts.	Acres under crop.	Yield cwts.	Acres under crop.	Yield cwts.	Acres under crop.	Yield cwts.	Acres under crop.	Yield cwts.	Acres under crop.	Yield cwts.	Acres under crop.	Yield cwts.
Lower Shire	52	138	...	...	5,895	17,780	287	427	...	...	...	...	...	...
Chikwawa	150	354	...	...	...	...	690	539	...	...	...	...	...	...
Central Shire	791	2,741	...	...	...	...	...	...	60	16	...	...	...	...
Cholo	6,053	23,499	1,066	670	1,966	5,797	...	...	62	4	...	...	...	...
Mlanje	1,834	5,234	6,523	11,896	...	...	6	12	111	17	...	...	...	...
Blantyre	2,906	11,490	...	...	...	...	5	5	487	389	...	...	10	10
Chiradzulu	1,667	7,099	...	...	...	...	16	17	...	...	...	...	...	...
Zomba	3,925	12,599	...	...	...	...	24	14	125	31	...	...	27	12
Upper Shire	183	984	...	...	...	...	...	...	...	...	...	...	...	...
South Nyasa	1,480	5,008	...	...	...	...	...	...	31	2	...	...	...	...
Ncheu	1,728	5,355	...	...	...	...	8	14	342	192	...	...	...	...
Dedza	572	1,710	...	...	...	...	...	...	4	2	...	...	2	2
Fort Manning	50	184	...	...	...	...	...	...	1	...	...	...	...	...
Lilongwe	866	3,649	...	...	...	...	10	16	...	...	...	...	...	...
Dowa	109	427	...	...	...	...	...	...	4	5	...	...	...	...
Kota Kota	...	...	...	...	...	...	...	...	3	...	...	...	...	...
Kasungu	20	40	...	...	...	...	...	...	...	...	...	...	...	...
Mombasa	...	...	...	...	...	...	...	...	1	1	...	...	...	...
West Nyasa	...	...	...	...	...	...	...	...	...	...	1,400	1,388	...	...
North Nyasa	194	844	7	3	2	8	...	...	50	6	...	...	...	...
Total	22,475	81,355	7,596	12,569	7,863	23,580	1,046	1,044	1,281	665	1,400	1,388	39	24
	62,230													



EUROPEAN AGRICULTURE, 1928—CONTINUED.

Name of District.	MAIZE AND MILLETS.		BEANS.		GROUNDNUTS.		WHEAT.		POTATOES.		MISCELLANEOUS.		TIMBER AND FIREWOOD.		Acres under crop.		Yield cwts.	
	Acres under crop.	Yield cwts.	Acres under crop.	Yield cwts.	Acres under crop.	Yield cwts.	Acres under crop.	Yield cwts.	Acres under crop.	Yield cwts.	Acres under crop.	Yield cwts.	Juccalyptus acres.	Others acres.				
Lower Shire ..	606	2,837	27	56	8	80			2	40	9	41	6	18	..	..	..	..
Chikwawa ..	437	1,498	27	100	..	..	1	4	..	..	..	..	20	..	..	..	..	..
Central Shire ..	158	1,170	17	26	..	..	1	1	..	..	..	..	37	33	..	..	..	..
Choto ..	605	5,854	979	3,574	14	23	10	46	..	..	150	491	2,892	348	..	..	..	..
Mlanje ..	685	5,801	1,647	2,803	..	..	2	11	..	..	18	15	556	334	..	..	..	..
Blantyre ..	348	3,422	176	209	..	..	8	52	..	..	96	964	2,039	54	..	..	..	..
Chiradzulu ..	420	4,081	304	878	..	..	1	3	2	5	127	247	2,288	177	..	..	..	..
Zomba ..	807	6,943	347	849	59	252	4	18	..	..	135	3,445	880	235	..	..	..	..
Upper Shire ..	46	685	47	251	5	25	..	..	..	..	..	..	4	15	..	..	..	..
South Nyasa ..	89	1,131	2	10	..	..	2	12	..	..	..	..	40	300	..	..	..	..
Ncheu ..	113	832	6	24	..	..	..	..	..	..	..	..	8	9	..	..	..	..
Dedza ..	10	100	2	4	..	..	19	101	27	666	2	15	66	337	..	..	..	..
Fort Manning ..	..	..	10	29	5	10	22	38	..	..	..	..	12	12	..	..	..	..
Lilongwe ..	136	1,254	16	39	..	..	..	..	..	..	..	..	67	36	..	..	..	..
Dowa ..	23	250	3	24	..	..	11	100	..	..	5	18	35	30	..	..	..	..
Kota Kota ..	20	500	5	5	..	..	4	18	1	10	1	2	..	12	..	..	..	..
Kasungu ..	3	20	..	..	..	..	..	..	..	..	..	..	8	9	..	..	..	..
Mombera ..	..	..	..	..	..	..	..	..	..	..	..	..	..	7	..	..	..	..
West Nyasa ..	..	..	10	50	10	40	..	..	..	..	..	..	1	..	..	..	..	..
North Nyasa ..	312	4,440	193	1,462	2	13	151	1,605	12	175	10	137	29	15	..	..	..	..
Total	4,812	40,818	3,818	10,384	103	423	236	2,009	44	896	553	5,375	8,983	1,981	..	..	..	..

# NATIVE AGRICULTURE, 1928.

District.	Seed Cotton.	Rice.	Wheat.	Ground- nuts.	Tobacco.	Maize.	Peas and Beans.
	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.
Lower Shire ...	1,377	—	—	—	—	—	—
Chikwawa ...	889	—	—	—	—	—	—
Central Shire ...	129	—	—	—	—	—	—
Cholo ...	—	—	—	—	81	—	—
Mlanje ...	10	—	—	—	143	—	—
Blantyre ...	4½	—	—	—	150	—	—
Chiradzulu ...	—	—	—	—	474	—	—
Zomba ...	—	—	—	—	204	—	—
Upper Shire ...	8	—	—	—	13	—	—
South Nyasa ...	1½	—	—	—	5	—	—
Ncheu ...	19	—	—	—	50	—	—
Dedza ...	11	—	—	—	22	—	—
Fort Manning ...	—	—	—	—	5	—	—
Lilongwe ...	—	—	—	—	820	—	—
Dowa ...	37	—	—	—	445	—	—
Kota Kota ...	—	—	—	—	1	—	—
Kasungu ...	—	—	—	—	1	—	—
Mombera ...	—	—	—	—	—	—	—
West Nyasa ...	—	—	—	—	—	—	—
North Nyasa ...	—	—	—	—	—	—	—
Total	2,486	—	—	—	2,414	—	—

NOTE.—Maize is the staple foodstuff in most districts; groundnuts, rice, wheat, beans, and various other crops are also grown by natives for local consumption, but it is impossible to make an accurate estimate of the quantities of any of these crops.

The above tobacco figures represent the quantities purchased in each district, and do not accurately reflect the production by districts, as many natives grow their tobacco in one district and sell in another.

## NATIVE LIVE STOCK, AS AT 31ST DECEMBER, 1928.

District.	Cattle.	Sheep.	Goats.	Pigs.
Lower Shire ...	69	1,100	8,400	9,750
Chikwawa ...	163	125	719	1,963
Central Shire ...	520	315	2,600	751
Cholo ...	60	300	4,000	2,000
Mlanje ...	85	600	4,000	2,000
Blantyre ...	1,022	1,007	4,240	687
Chiradzulu ...	1,452	946	5,544	5,605
Zomba ...	724	1,500	5,000	200
Upper Shire ...	32	3,692	9,180	68
South Nyasa ...	940	15,955	16,164	14,100
Ncheu ...	7,900	5,700	30,000	14,100
Dedza ...	11,800	13,100	24,000	9,000
Fort Manning ...	1,119	2,625	3,821	2,220
Lilongwe ...	12,500	15,000	39,000	4,000
Dowa ...	15,844	25,745	25,976	10,215
Kota Kota ...	1,800	4,992	5,900	1,300
Kasungu ...	3,527	3,778	3,101	—
Mombera ...	31,500	6,500	13,000	60
West Nyasa ...	4,750	448	1,870	—
North Nyasa ...	30,414	900	3,500	20
Total	126,221	104,328	210,015	78,039



LIVE STOCK OWNED BY EUROPEANS AT 31ST DECEMBER, 1928.

District.	Cows and Heifers over 1 year.	Bulls.	Oxen.	Calves.	Pedigree Cattle.	Horses.	Mules.	Donkeys.	Sheep.	Goats.	Pigs
Lower Shire ...	1,227	23	545	606	1	...	...	...	38	...	46
Chikwawa ...	607	10	461	294	...	...	...	17	6	...	...
Central Shire ...	40	4	49	18	...	...	...	3	9	29	10
Cholo ...	1,207	43	1,509	626	3	2	...	26	244	60	75
Mlanje ...	822	93	780	309	1	...	...	14	148	98	73
Blantyre ...	1,649	43	1,203	620	3	5	1	18	33	45	55
Chiradzulu ...	556	7	641	290	7	...	...	25	71	44	16
Zomba ...	1,586	40	1,770	674	35	2	2	40	339	11	197
Upper Shire ...	7	1	...	4	...	...	...	...	12	98	19
South Nyasa ...	113	7	75	60	1	...	...	1	143	99	...
Ncheu ...	288	12	136	91	3	...	...	9	28	26	101
Dedza ...	243	11	258	148	...	...	...	43	163	1	114
Fort Manning ...	...	...	10	...	...	...	...	...	...	...	...
Lilongwe ...	156	3	169	101	...	...	1	43	85	41	25
Dowa ...	68	6	58	48	...	...	...	15	75	...	32
Kota Kota ...	51	1	15	15	2	...	...	5	36	...	8
Kasungu ...	...	...	...	...	...	...	...	...	23	...	...
Mombera ...	14	2	6	4	...	...	...	4	...	...	...
West Nyasa ...	7	1	5	2	...	...	...	...	16	...	...
North Nyasa ...	143	8	173	109	...	...	...	2	65	4	27
Total	8,784	315	7,863	4,019	56	9	4	265	1,534	556	798









